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MONITORING REPORT ON THE GLANBROOK LANDFILL SITE

1982 (STACKS) SPEC. COLL.

Gartner Lee Associates Limited

Consulting Engineering Geologists and Hydrogeologists

Toronto-Buttonville Airport ■ Markham, Ontario ■ L3P 3J9 ■ 416-477-8400

SUPPLEMENTAL MONITORING STUDY REPORT GLANBROOK LANDFILL SITE

FOR

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

PROJECT 82-17

NOVEMBER, 1982

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Gartner Lee Associates Limited

Consulting Engineering Geologists and Hydrogeologists

Toronto-Buttonville Airport ■ Markham, Ontario ■ L3P 3J9 ■ 416-477-8400

November 23, 1982

Regional Municipality of Hamilton-Wentworth,
Department of Engineering,
71 Main Street West,
Hamilton, Ontario,
L8N 3T4.

Attention: Mr. J.R.G. Leach, P.Eng.,
Commissioner of Engineering

Dear Sirs:

Re: Supplemental Monitoring Study
Glanbrook Landfill Site

We are pleased to present our report on the results of the supplemental monitoring study at the Glanbrook Landfill Site. The study was initiated in response to your letter of February 19, 1982. The Region's purchase order R 41628 pertains to this work.

The principal objectives of the study can be summarized as follows:

a) to determine the relationship of the free water in the manholes along the sanitary sewer route and liquid from the leachate standpipe located inside these manholes. This work is being undertaken as the result of apparent contamination of the free water in the manholes.

b) to calculate the rate of leachate generation and compare this rate with design assumptions,

continued ..

c) to estimate the time interval remaining before the removal of leachate is necessary,

d) to comment on the presence of phenols in the ground water samples as documented in our report 80-114. dated January 14, 1982,

e) to complete the March 1982 ground water sampling for the Region.

The results of the March 1982 monitoring were forwarded under separate cover on March 29, and are not included in this report.

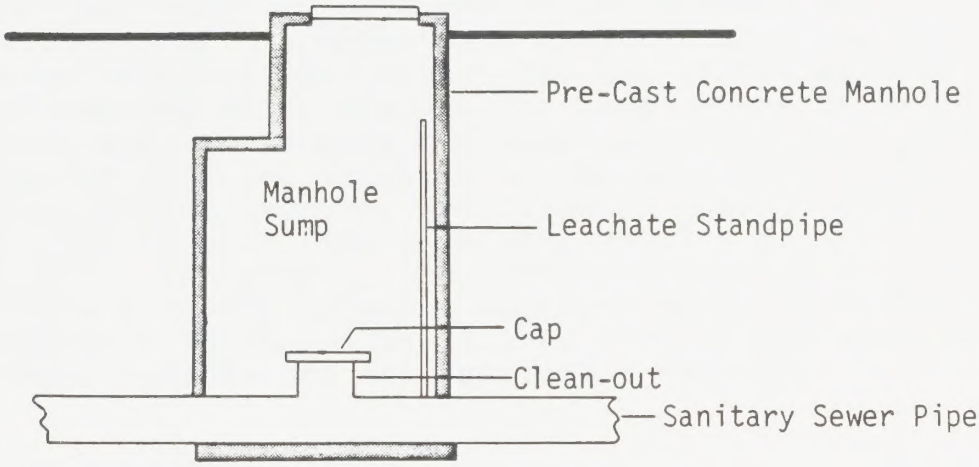
The study was carried out using an integration of field work, geochemical testing and office analysis. On March 24, 1982 the manholes designated 1, 3 and 4 on Figure 1, appended were inspected and water samples from the manhole sump and the leachate standpipe were collected. Manhole 2 was not included in the testing program as the leachate standpipe was blocked. Also the leachate standpipe in manhole 4 was blocked and could not be sampled. Water samples were submitted to the Region's laboratory for analysis. Results are shown on Table 1 in the appendix. Each of the manholes was to be pumped dry for the inspection, but due to faulty equipment the pumping was postponed. Regional staff carried out the pumping at a later date and reported the results to Gartner Lee Associates Limited. Water level measurements were also taken in the leachate standpipes and the adjacent ground water monitors in boreholes 24 and 25 on March 24. Following is a summary of the study findings, conclusions and recommendations.

A. SANITARY SEWER MANHOLES:

As we understand from the construction drawings, the perforated leachate collector pipe in cell 1 grades to the south-east corner. At this point, the collector pipe is joined to a solid polyethylene pipe which connects to the sanitary sewer main in manhole 4. The sanitary sewer main slopes northerly to manhole 1, and is continuous over its

continued ..

length including through the manholes. In each manhole there is a clean-out and a standpipe for sampling and measuring liquid levels. The manholes are constructed of pre-cast concrete sections. See the following schematic sketch for details.



Note: Actual detail may vary from that shown.

Not to Scale

SCHEMATIC SECTION MANHOLE

During the ground water monitoring program conducted through 1981, see our report 80-114, there was water in the manhole sump. Chemical analysis of this water showed what appeared to be elevated concentrations of certain parameters above ground water background. As a result, it was decided to investigate the situation in more detail.

As leachate was generated in the landfill, it flowed into the collector toe drain system and into the sanitary sewer system.

continued ..

Thus the first leachate generated was contained in the sewer pipe. The down-gradient end of the pipe was plugged in manhole 1 pending the future extension of the system. When Regional staff pumped the manhole sumps dry, they observed a leak from the clean-out. It was subsequently discovered that no gaskets were installed at the clean-outs in each of the manholes.

Thus the source of water in the manhole sumps is mainly from the sanitary sewer and this has ultimately come from the landfill. It is suspected that minor ground water infiltration may occur through the joints between the concrete sections of the manholes. As well there may be surface water infiltration through the top of the manhole. These other sources would account for some degree of variance in water quality between the sump water and the leachate as obtained from the leachate standpipe. Also it is noted that natural background ground water quality over the entire site is poor (see chemistry results in our report 80-114). In summary, the chemistry results as shown on Table 1 in the Appendix continue to be variable and are generally inconclusive at this time of any specific trends without considering the physical situation.

B. LEACHATE PRODUCTION:

The water levels in the leachate standpipes should be a reasonable reflection of the leachate level in the landfill. The elevation of the water varied from 189.1 m a.s.l. to 189.2 m a.s.l. or a difference of 0.1 m in the standpipes. See Table 2 in the Appendix for results. Thus the leachate elevation in the waste was assumed to be the arithmetic average of 189.20 m a.s.l. Based on this elevation, it is calculated that as of March 1982 there was about 5 million litres of leachate contained in the landfill. Since cell 1 has been developed in stages since operation commenced in October 1980, it is not feasible to relate this volume to an infiltration rate. Now that cell 1 is completely excavated, further monitoring of water levels and correlation of precipitation and climate conditions should provide data to calculate the current infiltration rates. Until this information is available an infiltration rate of 0.45 m/a can be assumed.

continued ..

Cell 1 is designed such that the south-east corner is the low point with a cell floor elevation of 187.5 m a.s.l. Thus as leachate is formed within the waste, it migrates towards the low point with an initial rapid build-up in level. As the surface area of the saturation zone expands the rate of increase in the level slows. As of March 24, 1982 the estimated elevation of the leachate, that is the top of the zone of saturation, was 189.2 m a.s.l. Based on these data, there is a zone of leachate saturation within about half the cell.

We understand that a condition of the operation is leachate levels must not be allowed to rise within two feet (0.6 m) of the ground surface. At that time leachate must be removed and a minimum 0.6 m free board maintained. The ground surface elevation in the south-east corner of Cell 1 as provided by the Region is 191.17 m a.s.l. This corner is the critical point as it is the lowest point in Cell 1 toward which leachate is moving. Thus the maximum allowed elevation of leachate mounding in Cell 1 is 190.57 m a.s.l. As of March 1982, then there was a buffer of about 1.4 m.

With the available data it is difficult to predict precisely when leachate removal may be required in Cell 1. Based on an infiltration rate of 0.45 m/a, a refuse porosity of 0.25 and assuming all refuse is at field moisture, the water level could theoretically rise 1 m in about 6 months. However it is unlikely the refuse is at field moisture. Therefore it is estimated that the critical height may be reached in 1½ to 2 years from last March, that is some time between September 1983 and February 1984. This timing however needs further confirmation. In this regard, a ground water monitor located in the south-east corner of Cell 1 is recommended. Also it is recommended that water levels be recorded in this new monitor and in the leachate standpipes on a monthly basis. Results should be plotted against time and correlated with precipitation.

C. PHENOLS:

As indicated in our report 80-114, the phenols measured in the ground water samples appear to have been leached from the PVC pipe installations. Testing has shown that PVC pipe will

leach phenols under certain conditions. There is at this time no other explanation for the phenols. It is however useful to continue to monitor for phenols as any increase in concentration above the established background may indicate an outside contaminant source.

RECOMMENDATIONS:

As a result of the study, we provide the following recommendations for your consideration:

- a proper seal should be placed on the sanitary sewer clean-outs, and the contaminated water in the manhole sumps removed and properly disposed of.

- reinstate the leachate standpipes in manholes 2 and 4.

- the manhole sumps should be monitored to confirm the integrity of the seal and to ensure there are no undetected problems.

- a ground water monitoring station should be established in the south-east corner of cell 1 to provide data on leachate levels and for sampling.

- leachate levels should be monitored in the new monitor and in the leachate standpipes in the manholes on a monthly basis. Results should be plotted against time and correlated with precipitation to provide data on infiltration rates and to predict more accurately future leachate levels in cell 1.

We thank you for the opportunity to be of service on this

project. If there are any questions, please contact us.

Yours very truly,

GARTNER LEE ASSOCIATES LIMITED

D. E. Jagger, P.Eng.,
Senior Project Engineer.
Associate.

DEJ:jcm

APPENDIX

PROJECT 82-17

TABLE 1 SHEET 1

WATER ANALYSIS RESULTS

LOCATION Glanbrook Landfill

REMARKS

PROPERTY		24 III 25 III Mean	24 III 25 III backgrd.	MH1 Sump	MH1 Leach-ate	MH1 Leachate Mean	MH3 Sump	MH3 Leachate	MH3 Leachate Mean	MH4 Sump	MH4 Leachate Mean	Ret. Pond Mean
CONDUCTIVITY μMHOS/CM.		4335	5700	290	(3000) 5600	2687	3500	2200	2558	3100	2492	1151
pH		7.3	7.5	6.9	7.3	7.0	8.1	7.2	7.3	7.7	7.3	8.0
HARDNESS ($Ca\,CO_3$)												
ALKALINITY ($Ca\,CO_3$)				134	593		326	523		419		
CHLORIDES (Cl)		46	53	9.5	102	62.5	44	20	58	64	59.6	52
SULPHATES (SO_4)			4600	42	2960		1600	580		1100		
PHOSPHOROUS AS P	Total											
	Soluble											
NITROGEN (N)	Total Kjeldahl		.3	<.3	<2		<.8	<2		<.8		
	Free Ammonia											
	Nitrite											
	Nitrate											
METALS	Potassium (K)		13.7	3.8	8.8		62	5.3		76		
	Magnesium (Mg)		679	5.8	544		220	160		188		
	Calcium (Ca)		432	38	440		300	260		228		
	Sodium (Na)		220	8.6	155		93	71		140		
	Iron (Fe)											
COD				28	15		13	23		14		

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

OPERATIONAL MONITORING REPORT
GLANBROOK SANITARY LANDFILL SITE
1982
THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

HYDROLOGY CONSULTANTS

April 8, 1983
Rexdale, Ontario

A.A. Sobanski, P. Eng.

Our File No. T 3866-HY

OPERATIONAL MONITORING REPORT
GLANBROOK SANITARY LANDFILL SITE
1982
THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

1.0 INTRODUCTION

At the request of the Regional Municipality of Hamilton-Wentworth, Hydrology Consultants has undertaken the interpretation of operational monitoring data collected in 1982. The chemical monitoring of the Glanbrook sanitary landfill was initiated in 1980 and is continuing on a routine basis.

A general location plan for the site is shown in Figure 1 and the locations of monitoring points are shown in Figure 2.

2.0 METHODOLOGY

Disposal at the site is currently taking place in Cell 2 near the southeast corner of the site. Cell 1 has also been covered with garbage. Monitoring of observation wells in the vicinity of these two cells is intense with conductivity, pH and chloride being undertaken on approximately a monthly basis with a more comprehensive analysis being done annually in October.

Wells are bailed of one casing volume of water prior to sampling to ensure a fresh groundwater sample. Monthly contaminant indicators of conductivity and pH are run with field equipment while the more comprehensive annual analysis and the monthly chloride analyses are carried out in the Region's laboratory.

Monitoring of the site is carried out in 9 nests of piezometers, 6 of which are located near the active landfill area and 3 which serve as background monitors and are located at varying distances from the landfill.

In addition to monitoring groundwater quality, the quality of leachate in the perimeter collector tile system is monitored and spot measurements have recently been made on nearby Buckhorn Creek. Gas monitors located near the waste area were monitored for methane gas in January and April, 1982.

3.0 HYDROGEOLOGY

Prior to sampling, static water levels were measured in the observation wells. Water level elevation data for the nests of observation wells are shown in Table 1A. All nests but Nest BH 12 demonstrated recharge groundwater gradients (decreasing head with increasing depth) which vary in magnitude from 0.15 at Nest BH 24 to 0.79 at Nest BH 5. The average value of the vertical gradient is 0.33.

Nest BH 12 near Buckhorn Creek displayed a discharge gradient of magnitude of 0.15 in 1982 (increasing head with increasing depth) but had a recharge gradient

of 0.09 in 1981. This may indicate that the nest is influenced intermittently by Buckhorn Creek.

The water levels in the tile collector manholes (Table 2A) have been relatively stable for the past year which could indicate that the waste has not reached field capacity or that the infiltration and exfiltration rates are in balance.

4.0 HYDROCHEMISTRY

4.1 Background Groundwater Quality

The groundwater quality in the area is poor and contains naturally high concentrations of chloride, hardness, sulphates and occasionally chromium and iron. The cause of the poor quality is natural mineralization (anhydrite and/or gypsum) that occurs in the underlying rock and apparently in the overlying glacial sediments. In spite of strong recharge gradients that aid in the circulation of fresh rainwater in the groundwater flow system, wells as shallow as 5 m (BH 17-III) contain high hardness concentrations of 700 to 1120 mg/L and high sulphate concentrations in the 600 to 1150 mg/L range. The sulphate concentration far exceeds the standards recommend by the Ministry of the Environment for drinking water (250 mg/L). In the underlying dolostone bedrock, a hardness of 1800 mg/L and a sulphate of 1500 mg/L occur at BH 1A-1.

Well nests representing background groundwater quality include Nests BH 1A, BH 5 and BH 17. There have been no significant changes in the quality of the groundwater

in Nest BH 1A except for phenols which have declined from values as high as 97 µg/L to non-detectable concentrations and chromium which has increased from <0.01 to about 0.09 mg/L. Phenol levels have likely declined as the glue used to construct the pipes has been removed with successive bailings. The cause of the chromium is not known. It could be natural or perhaps the samples were insufficiently filtered prior to acidification and analysis. The concentration likely does not exceed the Ministry of the Environment drinking water criteria of 0.05 mg/L as it is unlikely that the chromium is all present in the hexavalent form.

The mineralization in Wells BH 5-I and BH 5-II has decreased significantly in the past year. The decrease is as great as one to two orders of magnitude in BH 5-II. The cause of these lower chemical concentrations is not readily apparent. The COD concentrations in Wells BH 5-II and BH 5-III are noteably high at 72 and 88 mg/L, respectively.

4.2 Leachate Quality

The present leachate quality is shown by the chemistry of the waters obtained from Manholes 1, 2, 3 and 4 (Tables 3, 4, 5 and 6). For all intents and purposes, the leachate quality is similar to groundwater quality and the water contains few indicators of contamination by the waste other than slightly elevated concentrations of Kjeldahl nitrogen in the 4 to 10 mg/L range and a higher COD of 59 mg/L in Manhole 4. One can expect normal, fresh, landfill leachates to have COD concentrations in the tens of thousands mg/L range.

4.3 Groundwater In Vicinity Of Landfill

Monitors BH 12-I and 12-II, located west of waste Cell 2 display improving water quality with time. At BH 12-I, the conductivity has decreased from 3200 to 1250, the chlorides from 240 to 6 mg/L, the hardness from 1740 to 830 mg/L, the sulphate from 1680 to 530 mg/L and the phenol from 0.021 to 0 mg/L. The iron concentration increased from 0.12 to 0.37 mg/L. Similar decreases in mineralization were noted in Well BH 12-II.

Other than phenols there were no significant changes in the chemistry at BH 14-I located downgradient from the site. The phenols reportedly decrease from 0.211 to 0 mg/L. Wells BH 14-II and 14-III were dry. Routine monitoring indicated no change in the chemistry of water from BH 14-II and a reduction in chemical concentrations is indicated in shallow observation well BH 14-III.

At Nest BH 24, there were no significant chemical changes but some metals concentrations in BH 24-II were anomalously high with a chromium concentration of 0.15 mg/L, copper of 0.72 mg/L and iron of 5.0 mg/L.

Well BH 25-II had anomalous chemistry. While the conductivity remained unchanged from a last major sampling (6000), the chloride decreased from 80 to 3 mg/L, the hardness increased from 2350 to 5460 mg/L, the sulphate from 3250 to 4585 mg/L and the COD concentration was 441 mg/L. Metals concentrations were also greater than measured in the recent past. The concentrations of all of the above mentioned indicator parameters were much higher

than the strength of the leachate indicated by the chemistry in the leachate collector manholes. However, the high COD concentration could be indicative of leachate migration.

The chemistry measured at Nest BH 22 is unusual in that there has been a significant reduction in most chemical constituents but a high COD of 191 mg/L and a high iron 34 mg/L were measured at BH 22-II. This nest is located on a high traffic area in front of the site equipment building and it is believed that the location has affected the chemistry in the wells.

4.4 Surface Water

Spot quality measurements of chemical parameters for three locations on Buckhorn Creek (Figure 1) show that the site has had no impact on surface water resources (Tables 34, 35 and 36).

5.0 LANDFILL GASES

Methane gas concentrations were measured in site gas probes in January and April, 1982, with the following results:

	Gas % Methane	
Probe	25-04-82	29-04-82
GM-1	0	0.15
GM-2	0	0.15
GM-3	*	-
GM-4	*	0.125

*Could not open

Low concentrations of methane were detected in the probes in April, 1982, but are well below the lower explosive limit of 5 percent methane.

6.0 CONCLUSIONS

The natural quality of the groundwater in the area is very poor as a result of anhydrite and gypsum in the overburden and bedrock. Dissolution of these minerals gives rise to high values of conductivity, hardness and sulphate. The natural chloride concentration in the groundwater is high in some areas.

Phenol concentrations have declined significantly, likely as a result of the progressive removal of organic compounds in the glues used to construct the plastic wells by repeated bailings of the wells.

Some chemical changes have taken place since the last annual sampling. In a few cases, the quality of the groundwater has improved. The cause of this phenomena is not clearly understood. Heavy metals concentrations have increased in many of the monitoring wells. This may be due to inadequate filtration prior to preserving samples for heavy metals analysis.

The quality of the leachate at the site is weak according to the chemical results obtained from manholes along the leachate tile collector system. Only one well (BH 25-II) located adjacent to Cell 1 showed any evidence of possible leachate migration, but, this is not a certainty.

While the COD concentration was high at 441 mg/L, there was no phenol or chloride and the increase in the sulphate concentration was much greater than would be expected for landfill leachate.

There was no measureable impact from the site on the quality of the water in Buckhorn Creek.

Low concentrations of methane gas were measured in three probes in April, 1982, but there are sufficiently large municipal-owned buffers beyond the disposal area to prevent any off-site gas migration problems.

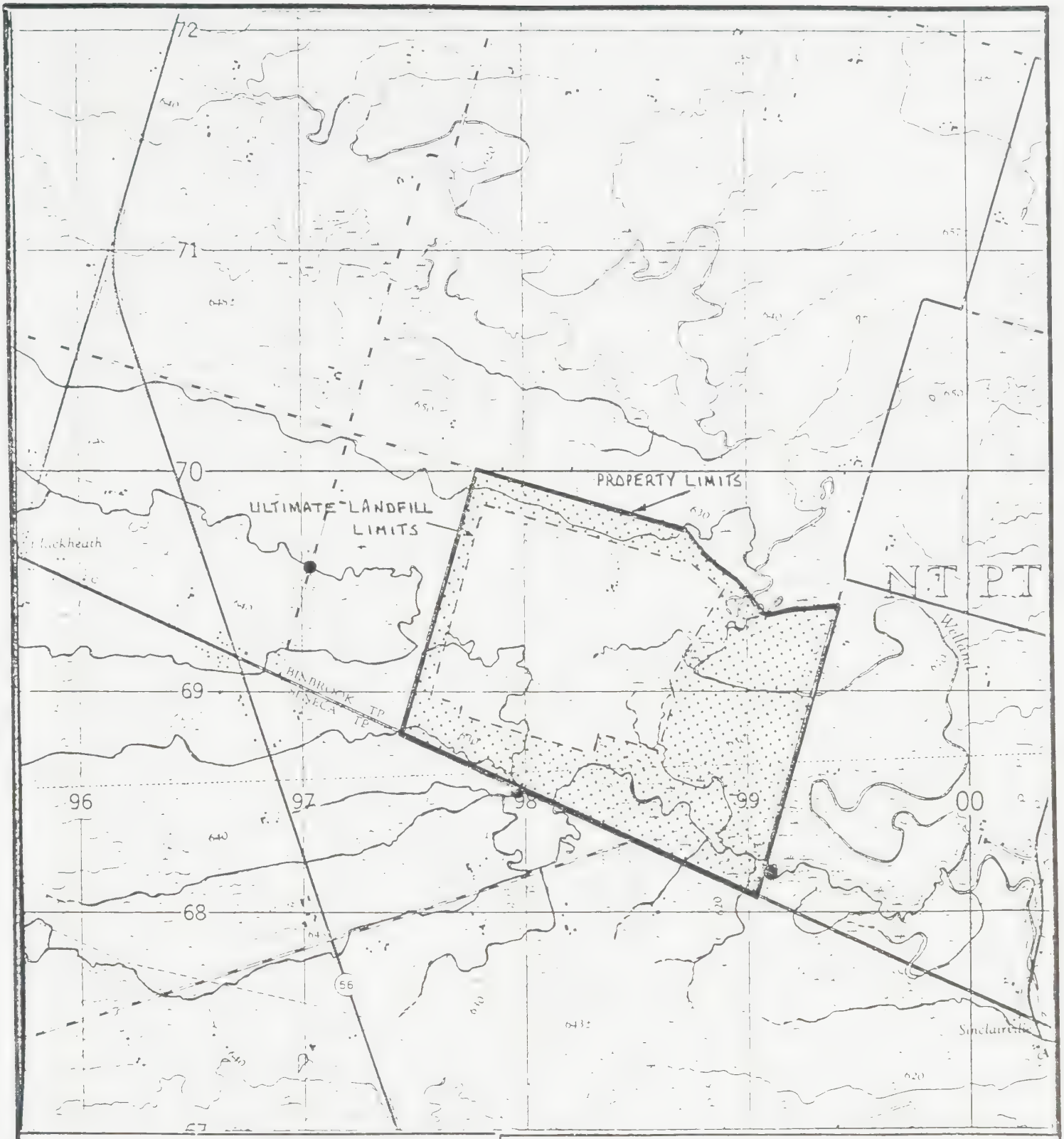
It is concluded that waste disposal at the site has thus far had a negligible impact on the aquatic environment.

7.0 RECOMMENDATIONS

1) It is recommended that samples collected for heavy metals analysis be adequately filtered through a 0.45 micron filter prior to preservation.

2) The sampling program and frequency recommended by Gartner Lee in the 1981 Operational Monitoring report released in early 1982 is ~~generally deemed to be adequate at this time.~~

3) The ~~natural~~ groundwater at the site is so highly mineralized that chemical changes that would result from leachate migration may be masked.



• Surface Water Sampling Station

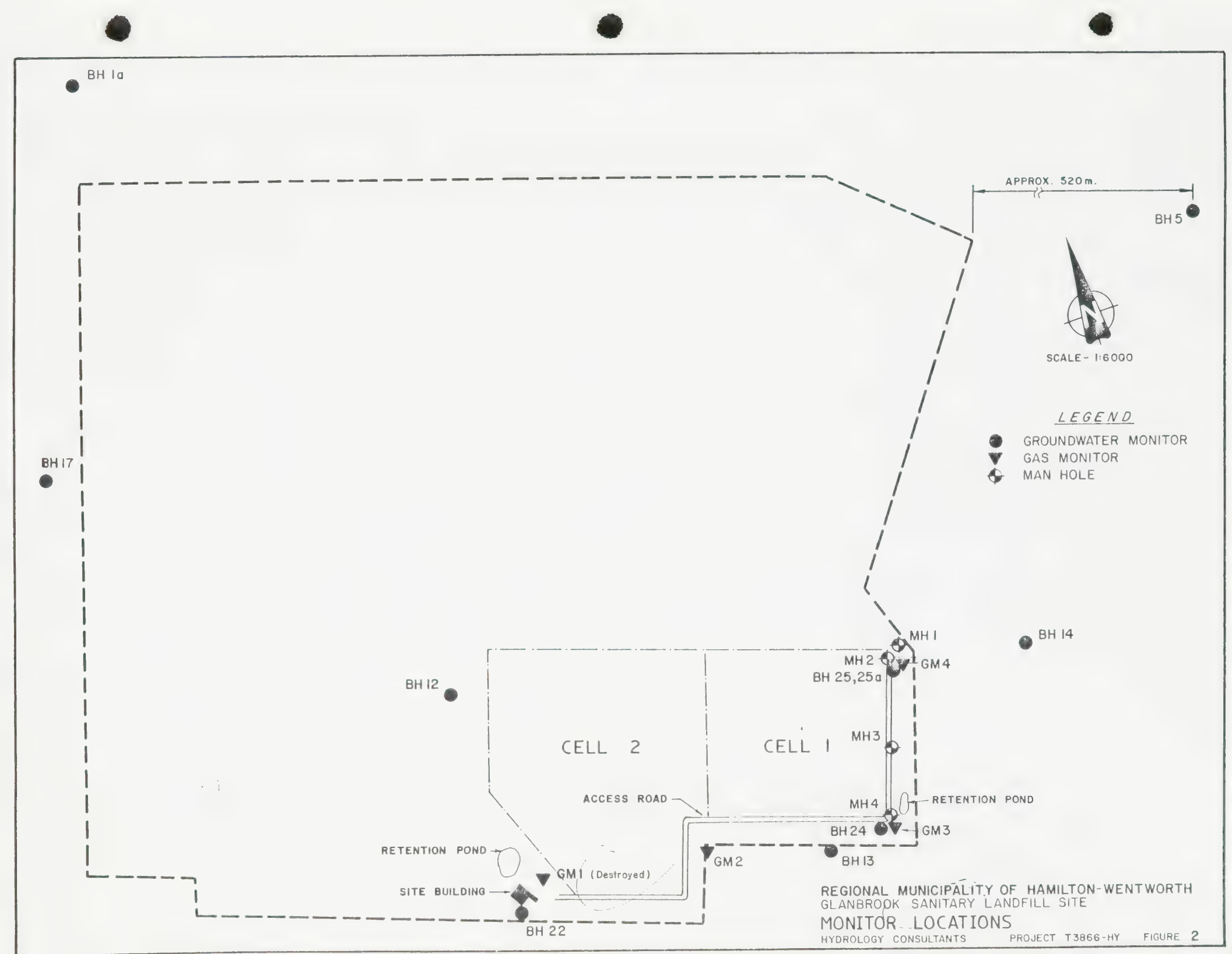
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL

Site location Plan

HYDROLOGY CONSULTANTS
CONSULTING ENGINEERS AND GEOLOGISTS

Job No	T 3866-HY	Scale	1:25,000
Drwn. by	AAS	Date	April, 1982
Appr. by	AAS		
Revised			

FIGURE 1


BH 1a
APPROX. 520m.
BH 5
SCALE - 1:6000
LEGEND
GROUNDWATER MONITOR
GAS MONITOR
MAN HOLE
BH 17
MH 1
BH 14
MH 2
GM 4
BH 25,25a
BH 12
CELL 2
CELL 1
MH 3
ACCESS ROAD
MH 4
RETENTION POND
BH 24
GM 3
RETENTION POND
GM 2
BH 13
GM 1 (Destroyed)
SITE BUILDING
BH 22
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
MONITOR LOCATIONS
HYDROLOGY CONSULTANTS
PROJECT T3866-HY
FIGURE 2

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE

TABLE 1A: WATER LEVEL DATA

WELL NUMBER	Depth metres	Ground Level mamsl.		DATE D/M/YR																	
				27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	28/04	20/05	25/06	29/07	26/08	29/09	15/10 1981	25/03 1982	22/10			
1a - I	19.5	191.19														187.6		187.0			
II	10.5	191.9														188.0		187.6			
III	6.1	191.9														190.4		189.9			
5 - I	11.7	189.88														186.7		184.7			
II	8.8	189.88														189.6		185.9			
III	7.0	189.88														188.9		188.3			
12 - I	14.3	191.47														187.1		187.0			
II	10.8	191.50														187.3		186.7			
III	6.1	191.50														187.8		185.8			
13 - I	18.7	189.72		184.7	183.6	183.8	185.3	184.9	182.6	183.8	183.8	181.4	182.7	184.3	184.1	181.4	185.9	185.2			
II	12.2	189.72		185.2	187.2	187.1	186.9	-	187.1	187.1	187.1	187.2	187.2	187.1	184.1	187.2	187.2	187.0			
III	10.1	189.72																187.0			
IV	5.2	189.88		188.5	188.4	188.6	188.6	189.0	188.8	189.2	189.2	189.0	188.7	188.3	188.8	188.8	-	188.1			
14 - I	17.7	194.11		185.3	185.8	185.6	185.6	186.0	185.9	185.8	185.8	186.2	185.8	185.8	185.7	185.9	185.9	185.5			
II	15.2	194.11		187.5	187.8	187.8	187.7	188.0	187.9	187.8	187.8	188.0	188.0	188.6	188.0	187.8	188.2	188.0			
III	9.1	194.30		190.5	190.5	190.7	189.6	191.0	190.9	191.2	191.2	191.3	190.9	191.1	191.3	191.4	191.6	190.5			
17 - I	9.6	188.60														187.2		187.1			
II	8.1	188.60														187.3		187.1			
III	5.3	188.60														187.6		185.8			
22 - I	10.1	190.75		185.4	187.3	-	187.3	187.4	187.2	187.2	187.2	187.4	187.4	187.2	187.3	187.3	187.4	187.1			
II	5.8	190.75		188.2	188.0	-	188.1	188.7	188.7	189.0	189.0	189.0	188.9	188.7	189.0	189.0	189.5	189.0			
24 - I	12.2	189.36		185.0	186.9	186.9	186.8	187.0	186.9	186.9	186.8	186.8	186.9	186.9	186.9	186.8	187.0	186.7			
II	7.0	189.36		187.6	187.7	187.5	187.5	188.0	187.7	187.8	187.7	187.8	188.0	187.4	187.7	187.6	188.0	187.5			
III	3.7	189.36		187.6	187.7	187.5	187.5	188.0	187.7	187.8	187.7	187.8	188.0	187.5	187.7	187.6	188.0	187.5			
25 - I	15.2	193.17		185.1	187.0	186.9	186.8	187.0	186.8	186.9	186.9	187.0	186.9	186.9	187.0	186.9	187.1	186.8			
II	7.3	193.17		188.5	188.6	188.7	188.7	189.2	189.1	189.3	189.4	189.4	189.4	189.4	189.5	189.5	189.9	189.5			
III	4.3	193.17		189.7	189.6	190.0	189.7	-	191.3	192.2	192.3	191.7	191.7	190.7	191.6	191.8	192.2	190.5			
25 a - I	7.3	193.11		188.4	188.6	188.8	188.7	188.9	189.2	189.3	189.5	189.5	189.5	189.4	188.0	-	190.0	189.5			

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 3 : MANHOLE 1

Constituent mg/L	DATE D/M/YR																			
	29/04 1981	22/05	25/06	29/07	27/08	29/09 1981	25/03 1982	19/10												
Conductance	2600	2250	1900	–	–	4000	230	2900												
pH	6.8	7.2	7.0	–	–	7.1	7.5	7.6												
Chloride	99	45	45	–	–	61	8	0.7												
Hardness								2270												
Sulphate								1400												
Kjeldahl N								4.32												
Nitrate								0												
Phenol								0												
BOD																				
COD								29												
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium								0.04												
Copper								0.02												
Iron								3.4												
Lead																				
Manganese																				
Nickel								0.04												
Zinc								0.52												

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 4 : MANHOLE 2

Constituent mg/L	DATE D/M/YR 19/10/1982																			
Conductance	2900																			
pH	7.5																			
Chloride	0.7																			
Hardness	2093																			
Sulphate	1540																			
Kjeldahl N	4.32																			
Nitrate	0.01																			
Phenol	0																			
BOD																				
COD	44																			
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium	N.D.																			
Copper	0.01																			
Iron	1.79																			
Lead																				
Manganese																				
Nickel	0.02																			
Zinc	0.03																			

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 5 : MANHOLE 3

Constituent mg/L	DATE D/M/YR																			
	29/04 1981	22/05	25/06	29/07	27/08	29/09 1981	25/03 1982	19/10												
Conductance	2050	2500	2500	2600	2700	3000	1200	3300												
pH	7.0	7.1	7.0	7.4	7.8	7.6	8.0	7.5												
Chloride	53	38	91	61	53	53	23	0.5												
Hardness								2335												
Sulphate								1720												
Kjeldahl N								8.32												
Nitrate								0.01												
Phenol								0												
BOD																				
COD								22												
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium								N.D.												
Copper								N.D.												
Iron								0.65												
Lead																				
Manganese																				
Nickel								0.03												
Zinc								0.02												

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 7 : BH 1A-I

Constituent mg/L	DATE D/M/YR																				
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982																		
Conductance	3100 2900	2900	3050																		
pH	7.8 7.8	7.5	7.2																		
Chloride	198 205	205	176																		
Hardness	1680 1600		1800																		
Sulphate	1550 1530		1500																		
Kjeldahl N	0.55 0.69		0.56																		
Nitrate	<0.05 <0.05		0.08																		
Phenol	0.097 0.025		N.D.																		
BOD	0.7 0.7																				
COD			22																		
TOC	1.0 1.0																				
Sodium	132 156																				
Potassium	6.7 6.8																				
Calcium	370 399																				
Magnesium	195 200																				
Phosphorus P																					
Cadmium	N.D. <0.01																				
Chromium	N.D. <0.02		0.09																		
Copper	N.D. <0.05		0.02																		
Iron	0.09 0.3		0.09																		
Lead	0.1 <0.1																				
Manganese	<0.1 <0.1																				
Nickel	N.D. 0.05		0.05																		
Zinc	0.1 <0.01		0.10																		

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 8 : BH 1A-II

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982																	
Conductance	2900 2900	2750	2600																	
pH	7.9 7.9	7.5	7.5																	
Chloride	260 262	235	200																	
Hardness	1530 1690		1445																	
Sulphate	1270 1260		1150																	
Kjeldahl N	0.94 0.59		0.32																	
Nitrate	<0.05 <0.05		0.67																	
Phenol	0.013 0.027		N.D.																	
BOD	0.7 4.7																			
COD			60																	
TOC	1.0 0.5																			
Sodium	129 142																			
Potassium	3.8 3.8																			
Calcium	287 301																			
Magnesium	203 206																			
Phosphorus P																				
Cadmium	N.D. <0.01																			
Chromium	N.D. <0.02		0.08																	
Copper	N.D. <0.05		0.02																	
Iron	0.07 1.34		0.79																	
Lead	0.1 0.1																			
Manganese	0.1 <0.1																			
Nickel	N.D. <0.05		0.02																	
Zinc	N.D. 0.01		<0.01																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 9 : BH 1A-III

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982																	
Conductance	2600 2500	2400	↑																	
pH	7.6 7.6	7.5																		
Chloride	110 112	99																		
Hardness	1170 <1270																			
Sulphate	920 1040																			
Kjeldahl N	0.72 4.0																			
Nitrate	<0.05 0.32																			
Phenol	0.027																			
BOD	2.6 –		D																	
COD			A																	
TOC	3.0 1.0		↓																	
Sodium	153 162																			
Potassium	4.7 4.3																			
Calcium	231 252																			
Magnesium	168 175																			
Phosphorus P																				
Cadmium	N.D. <0.01																			
Chromium	N.D. <0.02																			
Copper	N.D. <0.05																			
Iron	0.23 3.12																			
Lead	0.1 0.1																			
Manganese	0.8 0.75																			
Nickel	N.D. <0.05																			
Zinc	N.D. <0.01		↓																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 10 : BH 5-I

Constituent mg/L	DATE D/M/YR																				
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982																		
Conductance	2600 2680	2450	245																		
pH	7.5 7.7	7.5	7.7																		
Chloride	210 216	182	8																		
Hardness	1200 1350		105																		
Sulphate	1160 1210		13																		
Kjeldahl N	0.36 0.40		0.56																		
Nitrate	<0.05 —		1.10																		
Phenol	0.035 0.028		N.D.																		
BOD	0.5 0.9																				
COD			30																		
TOC	1.5 1.5																				
Sodium	112 130																				
Potassium	2.5 3.5																				
Calcium	288 305																				
Magnesium	151 150																				
Phosphorus P																					
Cadmium	N.D. <0.01																				
Chromium	N.D. <0.02		0.04																		
Copper	N.D <0.05		<0.01																		
Iron	0.12 0.56		0.02																		
Lead	0.1 <0.1																				
Manganese	1.1 1.45																				
Nickel	N.D. <0.05		<0.01																		
Zinc	N.D. 0.03		<0.01																		

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 11 : BH 5-II

Constituent mg/L	DATE D/M/YR																				
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982																		
Conductance	1750 1690	900	600																		
pH	7.9 7.9	7.0	8.0																		
Chloride	94 130	53	28																		
Hardness	750 750		316																		
Sulphate	530 600		110																		
Kjeldahl N	0.48 0.42		0.56																		
Nitrate	<0.05 <0.05		1.06																		
Phenol	0.015 0.024		N.D.																		
BOD	– 36																				
COD			73																		
TOC	4.5 1.0																				
Sodium	118 116																				
Potassium	1.5 1.0																				
Calcium	120 131																				
Magnesium	114 116																				
Phosphorus P																					
Cadmium	N.D. <0.01																				
Chromium	N.D. <0.02		0.03																		
Copper	N.D. <0.05		0.08																		
Iron	0.12 1.55		0.30																		
Lead	0.1 <0.1																				
Manganese	0.2 1.10																				
Nickel	N.D. <0.05		0.01																		
Zinc	N.D. <0.01		0.01																		

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 12 : BH 5-III

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	13/10 1982																	
Conductance	600 650	650	950																	
pH	7.9 8.2	7.5	7.5																	
Chloride	11 14	15	30																	
Hardness	320 350		545																	
Sulphate	160 150		225																	
Kjeldahl N	0.98 1.0		6.08																	
Nitrate	0.23 <0.05		0.06																	
Phenol	0.067 0.027		N.D.																	
BOD	1.3 2.2																			
COD			88																	
TOC	4.0 2.0																			
Sodium	7.3 14.0																			
Potassium	1.3 1.6																			
Calcium	63 82																			
Magnesium	27 46																			
Phosphorus P																				
Cadmium	N.D. <0.01																			
Chromium	N.D. <0.02		0.04																	
Copper	N.D. <0.05		0.01																	
Iron	0.65 1.62		3.90																	
Lead	0.1 <0.1																			
Manganese	0.3 0.3																			
Nickel	N.D. <0.05		0.04																	
Zinc	N.D. <0.01		0.01																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 13 : BH 12-I

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982																	
Conductance	3200 3150	2900	1250																	
pH	7.1 7.5	8.0	7.4																	
Chloride	240 243	227	6																	
Hardness	1720 1710		833																	
Sulphate	1490 1660		530																	
Kjeldahl N	0.38 0.42		0.56																	
Nitrate	<0.05 <0.05		N.D.																	
Phenol	0.007 0.021		N.D.																	
BOD	7.7 7.3																			
COD			22																	
TOC	2.0 <0.5																			
Sodium	139 156																			
Potassium	6.8 6.7																			
Calcium	410 424																			
Magnesium	160 166																			
Phosphorus P																				
Cadmium																				
Chromium			0.01																	
Copper			0.09																	
Iron	0.07 0.12		0.37																	
Lead																				
Manganese																				
Nickel			0.01																	
Zinc			0.01																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 14 : BH 12-II

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982																	
Conductance	2900 2650	1750	1250																	
pH	7.3 7.8	7.5	7.5																	
Chloride	60 67	38	5																	
Hardness	1820 1590		810																	
Sulphate	1560 1450		50																	
Kjeldahl N	0.46 0.33		0.32																	
Nitrate	<0.05 <0.05		0.12																	
Phenol	0.011 0.026		N.D.																	
BOD	0.9 0.5																			
COD			22																	
TOC	3.5 1.0																			
Sodium	77 88																			
Potassium	4.2 4.2																			
Calcium	274 280																			
Magnesium	278 249																			
Phosphorus P																				
Cadmium																				
Chromium			0.03																	
Copper			0.05																	
Iron	0.10 0.24		0.14																	
Lead																				
Manganese																				
Nickel			<0.01																	
Zinc			0.01																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 15 : BH 12-III

Constituent mg/L	DATE D/M/YR																			
	PRE - DISPOSAL 1980	15/10 1981	19/10 1982																	
Conductance		5900	↑																	
pH	8.3	7.5																		
Chloride		121																		
Hardness																				
Sulphate	4100																			
Kjeldahl N																				
Nitrate																				
Phenol																				
BOD																				
COD																				
TOC			D																	
Sodium	294		A																	
Potassium	10.9		T																	
Calcium	133		↓																	
Magnesium	995																			
Phosphorus P																				
Cadmium																				
Chromium																				
Copper																				
Iron	0.57																			
Lead																				
Manganese																				
Nickel																				
Zinc			↓																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 16A: BH 13-I

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	1500 1600	–	2500	2500	2500	1800	2800	3000	2750	–	–	2600	2750	2900	2400	2700	–	2900	2750	1700
pH	8.0 7.1	8.0	7.7	7.8	7.9	8.6	8.3	8.3	8.2	–	–	8.3	7.9	7.5	7.3	6.7	–	7.1	6.7	7.2
Chloride	– 130	180	182	122	193	240	227	205	167	–	–	235	212	225	227	195	–	173	118	102
Hardness	– 450													700						229
Sulphate	560 540													1225						835
Kjeldahl N														3.4						1.52
Nitrate														0.02						0.13
Phenol														0.040						0
BOD														0.3						
COD																				22
TOC	6.0 2.5																			
Sodium	145 166													185						
Potassium	9.6 11.0													2.9						
Calcium	49 63													110						
Magnesium	79 81													190						
Phosphorus P														0.3						
Cadmium	N.D. –													N.D.						
Chromium	N.D. –													N.D.						0.12
Copper	N.D. –													N.D.						0.06
Iron	<0.1 –													0.5						0.23
Lead	0.2 –													N.D.						
Manganese	1.3 –													0.1						
Nickel	N.D –													N.D.						0.01
Zinc	N.D –													N.D.						0.04

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 17A: BH 13-II

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	3050 2600	2200	2500	2400	2100	1800	1900	1900	2000	1700	1600	1650	1750	2100	1700	1700	1550	1720	1700	1250
pH	7.7 7.5	7.7	7.7	7.7	7.8	7.9	8.1	7.9	7.9	7.8	7.7	7.6	7.6	7.4	8.0	6.7	7.1	7.0	6.9	7.6
Chloride	260 218	165	182	182	171	200	144	144	114	180	152	174	129	215	159	121	106	97	115	78
Hardness	1570 1360													680						579
Sulphate	1670 1290													1200						350
Kjeldahl N	0.46 0.34													0.6						1.6
Nitrate	<0.05 <0.05													0						0.13
Phenol	0.0054 <.0024													0.047						0
BOD	0.7 0.5													0						
COD																				60
TOC	1.0 0.5																			
Sodium	159 154													160						
Potassium	4.6 2.9													3.5						
Calcium	406 293													320						
Magnesium	159 154													130						
Phosphorus P														0.06						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.01													N.D.						0.06
Copper	N.D. <0.05													N.D.						0.08
Iron	<0.1 <0.05													1.0						0.36
Lead	<0.1 <0.1													N.D.						
Manganese	0.1 0.1													0.1						
Nickel	N.D. <0.05													N.D.						<0.01
Zinc	N.D. <0.01													N.D.						0.07

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 18A: BH 13-IIII

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	1700 2100	1900	2000	2000	1900	900	1800	1530	1700	2100	1500	1600	1700	1850	-	1600	1550	1700	1600	1450
pH	8.2 7.9	7.0	7.5	7.2	7.3	7.3	7.6	7.5	7.3	7.6	7.6	7.4	7.6	7.2	-	6.6	7.1	6.9	6.9	7.7
Chloride	34 87	45	61	45	47	60	38	40	38	40	38	38	38	50	-	3	7	28	33	26
Hardness	806 1020													575						985
Sulphate	700 710													800						555
Kjeldahl N														0.5						2.08
Nitrate	<0.05 -													0.02						0.07
Phenol														0.134						0
BOD														0						
COD																				73
TOC	2.0 0.5																			
Sodium	144 59													75						
Potassium	2.7 29													3.3						
Calcium	237 152													165						
Magnesium	150 340													175						
Phosphorus P														3.12						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.08
Copper	N.D <0.05													N.D.						0.02
Iron	0.1 <0.05													2.4						2.2
Lead	0.2 <0.1													N.D.						
Manganese	0.1 <.00													1.2						
Nickel	N.D. <0.05													N.D.						0.01
Zinc	N.D. <0.01													0.03						0.02

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 19A: BH 14-I

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	2900 2580	3100	3100	3800	3500	2400	2900	3000	3500	2700	2800	2800	2900	3000	2500	2780	2700	3100	3020	2900
pH	7.8 7.4	7.5	7.5	7.4	7.4	7.6	7.3	7.7	7.7	7.5	7.7	7.8	7.7	7.2	7.3	6.8	7.3	7.0	6.8	7.6
Chloride	220 201	255	242	242	244	300	227	243	227	336	281	303	258	235	265	226	220	215	218	217
Hardness	1460 1340													825						1702
Sulphate	1310 1190													1500						1530
Kjeldahl N	1.1 1.4													1.6						1.28
Nitrate	<0.05 <0.05													0						0.24
Phenol	0.004 0.034													0.211						0
BOD	15 27													0.1						
COD																				30
TOC	3.5 2.0																			
Sodium	164 127													150						
Potassium	8.0 10.5													3.5						
Calcium	200 291													410						
Magnesium	136 146													140						
Phosphorus P														0.12						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						<0.02
Copper	N.D. <0.05													N.D.						0.52
Iron	0.1 0.1													0.4						0.17
Lead	0.2 <0.1													N.D.						
Manganese	0.1 0.1													<0.1						
Nickel	N.D. 0.05													N.D.						0.18
Zinc	N.D. <0.01													N.D.						0.02

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 20A: BH 14-II

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	2800 2830	3000	2600	3500	3000	2200	2200	2600	2800	-	2750	2200	2500	2500	2100	2600	-	-	2450	
pH	7.5 7.4	7.5	7.3	7.4	7.4	7.7	7.4	7.7	7.7	-	7.8	7.5	7.6	7.2	6.8	6.9	-	-	6.8	
Chloride	160 184	180	212	212	176	240	174	182	152	-	205	190	174	170	167	147	-	-	139	
Hardness	1500 1550													675						
Sulphate	1570 1440													1350						
Kjeldahl N	0.66 0.14													1.2						
Nitrate	0.19 <0.05													0.11						
Phenol														0.086						
BOD														0.2						
COD																				
TOC	30 2.5																			
Sodium	327 148													155						
Potassium	4.8 4.6													3.1						
Calcium	117 283													300						
Magnesium	213 205													140						
Phosphorus P														0.3						
Cadmium	N.D. —													N.D.						
Chromium	N.D. —													N.D.						
Copper	N.D. —													N.D.						
Iron	0.1 —													0.3						
Lead	0.1 —													N.D.						
Manganese	0.3 —													0.3						
Nickel	N.D. —													N.D.						
Zinc	N.D. —													0.03						

DAILY

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 21A: BH 14-III

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	6500 6380	7000	9000	7000	6500	6000	6000	5500	7000	5200	5300	4750	6000	6000	3750	5500	4500	6000	2450	
pH	7.5 7.7	7.5	7.0	7.5	7.0	7.1	7.1	7.2	7.1	7.5	7.4	7.4	7.3	6.6	7.3	6.9	7.2	6.8	6.7	
Chloride	240 231	240	212	227	229	270	227	243	178	305	243	258	212	135	220	38	10	24	171	
Hardness	4150 4410													1885						
Sulphate	4075 4130													2750						
Kjeldahl N	0.58 0.44													0.8						
Nitrate	0.15 0.09													0.04						
Phenol	0.066 0.045													0.205						
BOD	— 1.0													0.2						
COD																				
TOC	2.5 1.0																			
Sodium	343 364													430						
Potassium	11.6 12.4													3.7						
Calcium	474 533													515						
Magnesium	805 845													700						
Phosphorus P														0.10						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.01													N.D.						
Copper	N.D. <0.05													N.D.						
Iron	6.5 0.10													5.4						
Lead	0.3 <0.10													N.D.						
Manganese	0.6 0.55													0.7						
Nickel	N.D. 0.10													N.D.						
Zinc	<0.1 0.02													0.03						

DAILY

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 22 : BH 17-I

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982																	
Conductance	3200 3100	2700	2600																	
pH	7.7 7.8	7.5	7.6																	
Chloride	256 260	174	171																	
Hardness	1600 1690		1390																	
Sulphate	1510 1540		1285																	
Kjeldahl N	0.43 1.1		N.D.																	
Nitrate	<0.05 <0.05		0.08																	
Phenol	0.0065 0.022		N.D.																	
BOD	1.8 0.8																			
COD			60																	
TOC	1.0 <0.5																			
Sodium	348 170																			
Potassium	5.2 5.0																			
Calcium	495 391																			
Magnesium	166 168																			
Phosphorus P																				
Cadmium																				
Chromium			<0.01																	
Copper			0.03																	
Iron	0.08 0.74		0.07																	
Lead																				
Manganese																				
Nickel			0.02																	
Zinc			0.02																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 23 : BH 17-II

Constituent mg/L	DATE D/M/YR																				
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982																		
Conductance	3100 2830	2300	2250																		
pH	8.0 7.8	8.0	7.7																		
Chloride	190 186	121	100																		
Hardness	720 230		795																		
Sulphate	1100 1130		985																		
Kjeldahl N	40 18		0.53																		
Nitrate	0.14 <0.05		0.16																		
Phenol	0.014 <0.7		N.D.																		
BOD	15 7.3																				
COD			45																		
TOC	2.5 0.5																				
Sodium	140 278																				
Potassium	35 17																				
Calcium	269 216																				
Magnesium	76 104																				
Phosphorus P																					
Cadmium																					
Chromium			<0.01																		
Copper			0.03																		
Iron	0.14 0.18		0.16																		
Lead																					
Manganese																					
Nickel			0.01																		
Zinc			0.01																		

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 24 : BH 17-III

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982																	
Conductance	2350 2280	2200	1550																	
pH	7.6 8.0	7.0	7.3																	
Chloride	38 60	38	32																	
Hardness	1100 1040		676																	
Sulphate	1150 1140		605																	
Kjeldahl N	26 12		6.83																	
Nitrate	0.30 0.33		3.17																	
Phenol			N.D.																	
BOD																				
COD			22																	
TOC	2.5 <0.5																			
Sodium	101 167																			
Potassium	18 19																			
Calcium	230 212																			
Magnesium	142 133																			
Phosphorus P																				
Cadmium																				
Chromium			0.01																	
Copper			0.14																	
Iron	0.21 0.82		3.17																	
Lead																				
Manganese																				
Nickel			0.04																	
Zinc			0.04																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 25A: BH 22-I

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	2900 2680	2500	3000	–	2250	2800	2700	2100	2500	2400	2000	2400	3000	2900	2050	3200	3200	5500	850	600
pH	7.7 7.7	8.0	7.5	–	7.4	7.6	7.3	7.4	7.0	7.2	7.3	7.1	7.4	7.1	7.5	6.8	7.1	7.2	7.2	7.7
Chloride	260 205	150	217	–	186	240	159	152	167	380	243	281	243	260	258	112	10	81	112	53
Hardness	1400 1405													790						2250
Sulphate	1420 1310													1450						120
Kjeldahl N	0.62 0.70													1.8						0.24
Nitrate	<0.05 0.15													0.08						0.75
Phenol	0.0074 0.030													0.0026						0
BOD	1.7 0.5													0						
COD																				–
TOC	2.0 <0.5																			
Sodium	4.8 143													170						
Potassium	5.3 4.8													4.1						
Calcium	132 297													400						
Magnesium	155 159													135						
Phosphorus P														0.08						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.06
Copper	N.D. <0.05													N.D						<0.01
Iron	0.4 0.15													0.6						0.24
Lead	0.1 <0.10													N.D.						
Manganese	0.4 0.20													0.3						
Nickel	N.D. <0.05													N.D.						0.13
Zinc	N.D. <0.01													0.04						<0.01

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 26A: BH 22-II

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	5650 –	6000	7000	–	2000	5000	5000	5000	6000	4300	4250	4500	6500	5000	3600	2350	1200	5200	700	850
pH	7.3 –	7.0	7.5	–	7.2	7.1	7.0	8.0	8.2	8.0	8.0	7.8	7.2	6.6	7.0	6.6	7.6	7.2	7.3	7.5
Chloride	129 136	150	121	–	69	180	98	121	129	165	121	144	129	130	129	135	127	143	108	68
Hardness	3900 4160													2150						460
Sulphate	4350 –													2750						280
Kjeldahl N	0.13 0.55													1.4						8.0
Nitrate	<0.05 –													0.06						0.75
Phenol	0.014 0.028													0.013						0
BOD														0.5						
COD																				191
TOC	4.0 <0.5																			
Sodium	270 253													290						
Potassium	7.2 7.3													3.5						
Calcium	486 459													500						
Magnesium	707 788													820						
Phosphorus P														1.12						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.10
Copper	N.D. <0.05													<0.1						0.09
Iron	3.0 0.15													3.3						34.0
Lead	0.2 <0.10													1.5						
Manganese	3.0 0.15													3.4						
Nickel	<0.1 0.10													N.D.						0.09
Zinc	0.1 <0.01													0.6						0.20

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 27A: BH 24-I

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	3200 3170	3500	3600	4000	3750	3300	3200	3000	3500	2600	2600	2600	3500	3100	2300	2610	2500	2900	2800	2950
pH	7.7 7.7	7.5	7.7	7.5	7.5	7.6	7.8	7.6	7.1	7.5	8.0	7.3	7.4	7.3	7.7	6.9	7.5	7.4	7.0	7.3
Chloride	247 549	300	273	280	227	270	182	280	243	330	296	303	258	275	281	238	237	215	241	230
Hardness	1600 1630													830						1209
Sulphate	1700 1800													1550						1430
Kjeldahl N	0.17 0.51													1.2						1.40
Nitrate	0.62 <0.1													0.03						0
Phenol	0.034 0.022													0.012						0
BOD	38 10													3.0						
COD																				—
TOC	4.0 5.4																			
Sodium	146 138													165						
Potassium	18.6 8.4													4.1						
Calcium	315 342													435						
Magnesium	208 188													155						
Phosphorus P														0.20						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.02
Copper	N.D. <0.05													—						0.09
Iron	0.1 0.1													0.3						0.30
Lead	0.1 0.1													0.3						
Manganese	0.1 <0.10													0.1						
Nickel	N.D. 0.05													N.D.						0.03
Zinc	N.D. 0.02													N.D.						0.01

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 28A: BH 24-II

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	4300 4500	5000	5200	6000	5000	3800	4000	3400	5000	3300	3500	3250	4300	2900	2600	3120	3100	3500	3520	3450
pH	7.6 7.4	7.0	7.5	7.2	7.2	7.2	7.5	7.3	7.0	7.5	7.5	7.2	7.3	6.7	7.3	6.9	7.3	6.9	6.9	7.7
Chloride	123 78	75	91	83	84	120	61	68	61	92	68	61	53	50	45	7	8	37	58	53
Hardness	2000 2370													1305						2252
Sulphate	2900 3000													2300						1945
Kjeldahl N	0.75 0.63													0						1.28
Nitrate	1.6 <0.1													0.06						0
Phenol	0.036 0.024													0						0
BOD	30 23													0						
COD																				15
TOC	2.0 12																			
Sodium	360 260													150						
Potassium	29 15.4													3.5						
Calcium	445 435													410						
Magnesium	268 377													400						
Phosphorus P														0.02						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.15
Copper	N.D. <0.05													N.D.						0.72
Iron	12.0 6.0													10.5						5.0
Lead	0.2 <0.10													N.D.						
Manganese	0.6 0.5													0.5						
Nickel	<0.1 0.5													N.D.						0.06
Zinc	0.1 0.04													N.D.						0.05

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 29A: BH 24-III

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	4300 4050	4500	5000	6000	4000	3800	3500	3250	3600	3000	3000	3000	4000	3350	2500	3260	3000	3820	3680	3200
pH	7.7 7.6	7.0	7.0	7.1	7.2	7.1	7.4	7.3	7.1	7.0	7.2	7.3	7.3	6.7	7.3	6.9	7.2	6.8	6.9	7.6
Chloride	38 1065	45	61	53	49	90	40	40	38	61	45	45	38	35	45	5	8	37	40	21
Hardness	2800 2450													1150						2275
Sulphate	3200 2800													1950						1945
Kjeldahl N	0.41 0.22													0.80						2.08
Nitrate	0.18 0.15													0.35						0.55
Phenol	0.024 0.022													0						0
BOD	24 2.8													0						
COD																				14
TOC	4.0 7.9																			
Sodium	214 144													120						
Potassium	16.9 7.1													3.7						
Calcium	445 444													255						
Magnesium	440 437													380						
Phosphorus P														0.10						
Cadmium														N.D.						
Chromium														N.D.						0.02
Copper														N.D.						0.05
Iron														3.7						2.7
Lead														N.D.						
Manganese														0.5						
Nickel														N.D.						<0.01
Zinc														N.D.						<0.01

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 30A: BH 25-I

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	2900 2850	3100	3400	3500	3000	1900	2800	2700	2600	2500	2300	2300	2750	2100	2050	2370	2250	2600	2680	2750
pH	7.6 7.5	7.5	7.7	7.3	7.6	7.4	7.9	7.8	7.5	7.6	7.4	7.5	7.5	7.2	7.8	6.4	7.5	7.1	7.2	7.7
Chloride	147 149	180	182	174	152	210	175	197	152	180	190	205	167	190	159	145	138	142	141	142
Hardness	1900 1590													735						1581
Sulphate	1900 1700													1450						1285
Kjeldahl N	0.68 0.97													1.6						1.04
Nitrate	0.10 <0.1													0.02						0.05
Phenol	0.039 0.025													0.049						0
BOD	107 5.3													0.1						
COD																				22
TOC	4.0 4.0																			
Sodium	134 120													150						
Potassium	9.0 4.6													3.5						
Calcium	268 329													310						
Magnesium	157 174													155						
Phosphorus P														0.08						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.08
Copper	N.D. <0.05													N.D.						0.34
Iron	0.8 <0.05													0.5						0.58
Lead	0.1 0.20													N.D.						
Manganese	0.1 <0.10													<0.1						
Nickel	N.D. <0.05													N.D.						0.03
Zinc	<0.1 <0.01													0.02						0.01

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 31A: BH 25-II

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	2900 4700	5800	6000	6000	6000	1000	5500	5000	6000	5000	5500	4750	6500	6000	4000	6000	4500	6500	6500	6000
pH	7.6 7.9	7.0	7.0	7.2	7.1	6.8	7.4	7.3	7.0	7.3	7.1	7.1	7.2	6.5	7.0	6.6	7.1	6.8	6.8	7.4
Chloride	143 143	113	152	121	98	150	106	106	98	120	106	106	83	80	91	30	10	21	15	3
Hardness	1500 2840													2350						5460
Sulphate	1600 3300													3250						4585
Kjeldahl N	0.85 0.47													0.8						1.28
Nitrate	<0.1 <0.1													0.02						0.22
Phenol	0.026 0.024													0.059						0
BOD	— 5.2													0						
COD																				441
TOC	2.5 5.2																			
Sodium	148 164													255						
Potassium	9.5 9.0													3.3						
Calcium	294 355													475						
Magnesium	198 565													970						
Phosphorus P														0.42						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.11
Copper	N.D. <0.05													N.D.						0.66
Iron	<0.1 0.10													0.6						2.2
Lead	0.2 <0.10													N.D.						
Manganese	2.2 2.3													2.5						
Nickel	0.1 0.13													N.D.						0.07
Zinc	<0.1 0.01													N.D.						0.16

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 32A: BH 25-III

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	7200 7500	8000	10000	7000	8000	-	3000	2600	2800	2400	2900	2900	3000	2700	1900	2500	1900	2500	2850	3200
pH	7.4 7.8	7.5	7.3	7.5	7.0	-	7.7	7.5	7.3	7.8	7.4	7.4	7.3	6.9	7.5	6.6	7.5	7.2	7.0	7.7
Chloride	57 50	57	61	106	61	-	23	23	15	30	30	30	23	60	15	2	8	5	14	1
Hardness	5400 5490													975						2225
Sulphate	6000 6600													1550						1760
Kjeldahl N	1.07 0.35													0.5						1.04
Nitrate	0.27 <0.1													1.75						0.98
Phenol	0.023 0.023													0.092						0
BOD	6 1.9													0						
COD																				37
TOC	3.5 7.5																			
Sodium	274 250													155						
Potassium	179 132													3.1						
Calcium	445 395													320						
Magnesium	590 1252													135						
Phosphorus P														0.32						
Cadmium														N.D.						
Chromium														N.D.						0.09
Copper														-						0.04
Iron														1.3						1.2
Lead														N.D.						
Manganese														<0.1						
Nickel														N.D.						<0.01
Zinc														N.D.						<0.01

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 33A: BH 25-AI

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	5100 –	6000	6000	7000	6000	3500	5000	4500	5000	4000	5000	4000	5500	-	3300	4500	3500	4400	—	4300
pH	7.1 –	7.0	7.0	7.3	7.1	6.9	7.5	7.1	7.0	7.0	7.0	7.1	7.1	-	7.0	6.8	7.1	6.5	—	6.7
Chloride	76 –	98	121	106	91	135	98	121	91	122	99	106	76	-	83	8	6	66	—	1
Hardness	3600 –																			3115
Sulphate	3400 –																			2640
Kjeldahl N	0.73 –																			10.13
Nitrate	0.64 –																			0.06
Phenol	0.007 –																			0
BOD																				
COD																				59
TOC	3.0 –																			
Sodium	194 –																			
Potassium	11.1 –																			
Calcium	400 –																			
Magnesium	640 –																			
Phosphorus P																				
Cadmium	N.D. 0.02																			
Chromium	N.D. <0.02																			0.10
Copper	N.D. <0.05																			0.11
Iron	0.4 5.8																			3.6
Lead	<0.1 1.30																			
Manganese	1.2 2.10																			
Nickel	<0.1 0.07																			0.02
Zinc	<0.1 0.75																			0.03

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
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TABLE 34 : UPSTREAM BUCKHORN CREEK

Constituent mg/L	DATE D/M/YR 19|10|1982																			
Conductance	1800																			
pH	7.1																			
Chloride	64																			
Hardness																				
Sulphate																				
Kjeldahl N																				
Nitrate																				
Phenol																				
BOD																				
COD																				
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium																				
Copper																				
Iron																				
Lead																				
Manganese																				
Nickel																				
Zinc																				
Dissolved Oxygen	10.8																			

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WATER CHEMISTRY

TABLE 35 : BUCKHORN CREEK AT TOWNLINE ROAD

Constituent mg/L	DATE D/M/YR 19/10/1982																			
Conductance	1050																			
pH	6.9																			
Chloride	168																			
Hardness																				
Sulphate																				
Kjeldahl N																				
Nitrate																				
Phenol																				
BOD																				
COD																				
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium																				
Copper																				
Iron																				
Lead																				
Manganese																				
Nickel																				
Zinc																				
Dissolved Oxygen	10.2																			

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 36 : DOWNSTREAM BUCKHORN CREEK

Constituent mg/L	DATE D/M/YR 19/10 1982																			
Conductance	1200																			
pH	6.9																			
Chloride	86																			
Hardness																				
Sulphate																				
Kjeldahl N																				
Nitrate																				
Phenol																				
BOD																				
COD																				
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium																				
Copper																				
Iron																				
Lead																				
Manganese																				
Nickel																				
Zinc																				
Dissolved Oxygen	9.2																			

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